

# A Study of the Chital or Spotted Deer in Corbett National Park, Uttar Pradesh

BY

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(With three maps)

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Map 1. Map of Corbett National Park, U.P. . . . . . 577

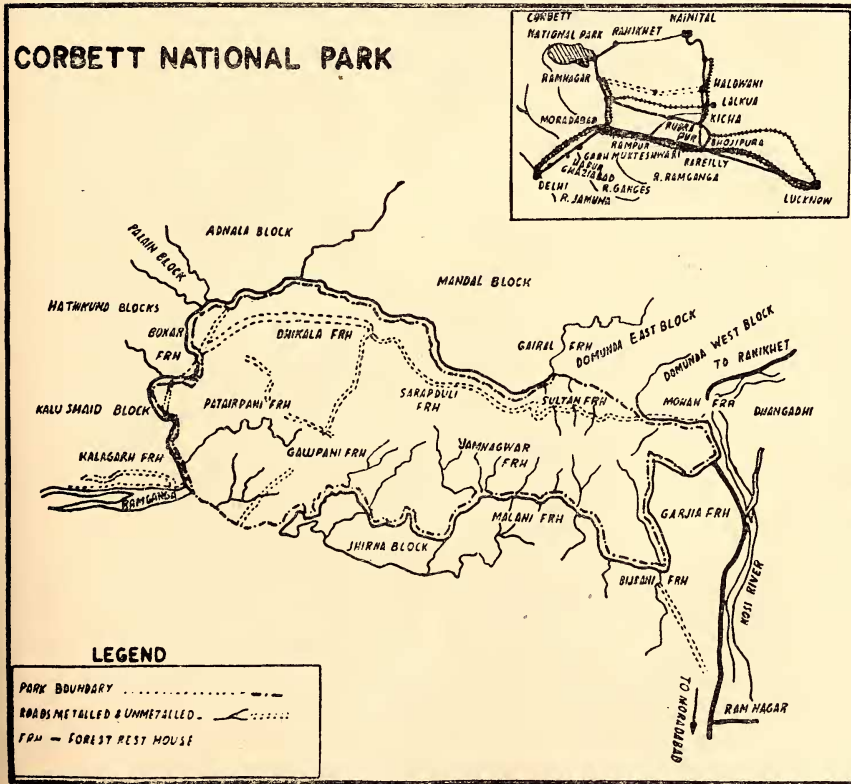
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I. INTRODUCTION

Corbett National Park, so named since 1957, has the distinction of being India's first national park. It was first constituted in 1935 as the Hailey National Park, later as the Ramganga National Park, and finally as Corbett.

This 125-square-mile park is located in the rugged Himalayan foothills in the districts of Nainital and Garhwal of Uttar Pradesh (U.P.). The Ramganga River forms the northern and western boundaries, the Ramnagar-Ranikhet road the eastern boundary and the Ramnagar-Kotdwara road the southern boundary (Map 1). Corbett Park is sur-



Map 1. Map of Corbett National Park, U.P.

rounded by shooting blocks. Shooting, however, has been fully prohibited in the Jhirna Block and partially in the Bijrani and Mandal Blocks, with the reported expectation that these areas totalling about 32-square-miles will soon be included in the park. Approximately 60 miles of fair weather roads inside Corbett Park are maintained by the Forest Department. The park is closed to the public during the monsoon season, mid-June to October.

Dhikala is the main visitor center. Located here are two Forest Rest Houses, a hutment, a number of tents for visitors and houses for 14 members of the Forest Department staff. Forest Rest Houses are also located at Sultan, Sarapduli, Boxar, Patairpani, Gajpani, Jamnagwar and Malani. Corbett is under the jurisdiction of the State Forest Department and is supervised by a wild life warden, with a staff of several assistant wild life wardens and a number of wild life guards.

Numerous forms of mammals, some of which are listed in Table 1, are present in Corbett. In addition, several hundred species of birds have been reported, as well as several species of tortoises, snakes (both non-poisonous and venomous), and other reptiles. The 'Indian salmon' or *mahseer* (*Barbus tor*) is the most notable of the fish species found in the Ramganga River and the larger streams.

An irrigation and hydroelectric dam, to be completed in 1973, is presently under construction at Kalagarh. An area of approximately 18-square-miles of grasslands within the park, including parts of the Patairpani, Dhikala, and Gajpani forest blocks, will be inundated after the completion of the dam (Map. 2). The most common large mammal in the park is the chital, the vast majority of which inhabit these grassland areas which will be submerged. Therefore, the primary objectives of this study were to determine the present status of the chital in this area from the standpoint of their population density, movements, sex ratios, and age composition. Hopefully this report will provide information that will be useful in the preservation of wild life, particularly the chital, after the environment has been altered by the advent of the dam. Also that it will serve as a comparative basis for future studies, which may help to determine how wild life can best be considered in future projects of this nature.

The main area of study was in the vicinity of the tourist center at Dhikala, located at an elevation of 1265 feet. It consisted of about seven-square-miles of open grasslands, locally called *chaur*, and the adjoining forest areas. About four square miles were in the Khinanauli Block and about three in the forests of the Dhikala Block (Map. 3).

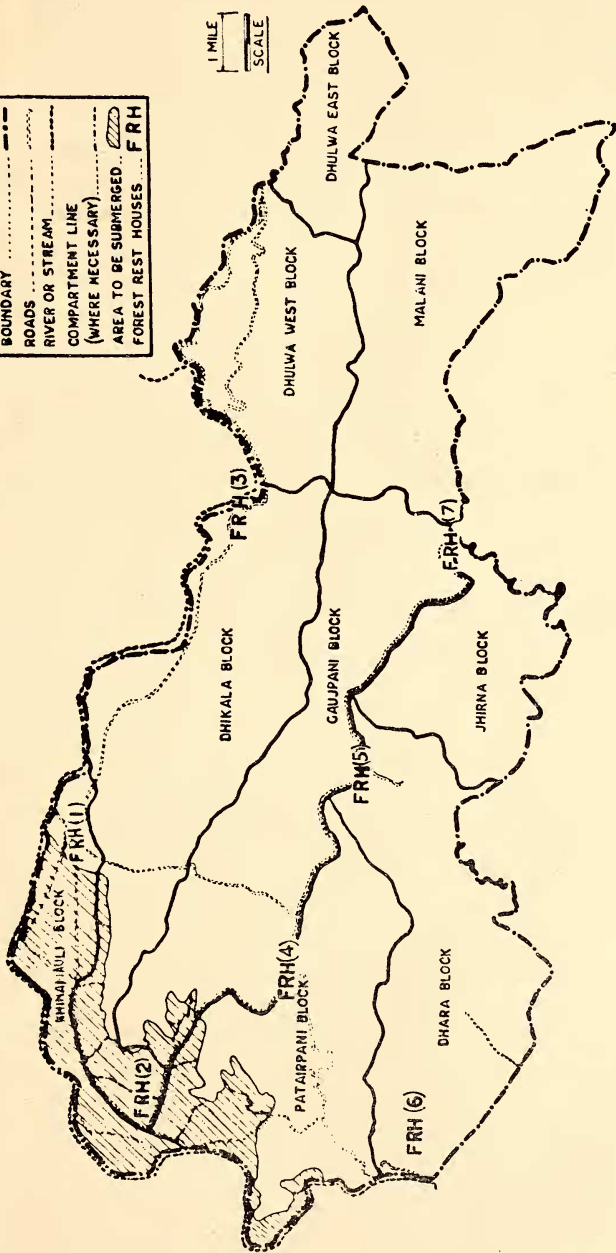
Daily observations were made from 04:30 to 11:30 hours and from 14:30 to 19:30 hours. Eight-power binoculars or a 20-60 x zoom spotting scope were used. Three watch towers or wooden machans in the *chaur* were also frequently used for observations.

# CORBETT NATIONAL PARK

## LEGEND

BOUNDARY	---
ROADS	----
RIVER OR STREAM	~~~~~
COMPARTMENT LINE (WHERE NECESSARY)	.....
AREA TO BE SUBMERGED	▨
FOREST REST HOUSES	FRH

1 MILE  
SCALE



Map 2. Map of Corbett National Park, U.P., depicting the area to be submerged by the Ramganga Dam Project and the forest blocks inside the park

TABLE I

SOME OF THE LARGER ANIMALS REPRESENTED IN CORBETT NATIONAL PARK, U.P.

Common Name	Local Name	Scientific Name
Indian Elephant	Hathi	<i>Elephas maximus</i>
Sambar	Sambar	<i>Cervus unicolor</i>
Chital	Chital	<i>Axis axis</i>
Hog Deer	Para	<i>Axis porcinus</i>
Barking Deer	Kakar	<i>Muntiacus muntjak</i>
Tiger	Sher or Bagh	<i>Panthera tigris</i>
Leopard	Guldar	<i>Panthera pardus</i>
Hyaena	—	<i>Hyaena hyaena</i>
Sloth Bear	Bhalu	<i>Melursus ursinus</i>
Himalayan Black Bear	Bhalu	<i>Selenarctos thibetanus</i>
Wild Boar	Suar	<i>Sus scrofa</i>
Rhesus Monkey	Bandar	<i>Macaca mulatta</i>
Common Langur	Hanuman	<i>Presbytis entellus</i>
Porcupine	Soohi	<i>Hystrix indica</i>
Marten	Chitrole	<i>Martes flavigula</i>
Mugger	Magar	<i>Crocodilus palustris</i>
Gharial	Gharial	<i>Gavialis gangeticus</i>
Python	Ajgar	<i>Python molurus</i>

## II. HABITAT

The study area can be roughly divided into three vegetational types : (1) *chaur* or savannah-like grasslands, (2) *sal* forest, and (3) river bed.

The Dhikala *chaur* was formed by past cultivation. The Ramganga River forms the northern and western boundaries and the Thandi-Sarak road runs along the edge of the forest on the south and east. The vegetation consists primarily of grasses such as *suthi* (*Aristida cyanantha*), *Cymbopogon confortiflorus*, *Arundinella nepalensis*, *bichroo* (*Neyraudia arundinacea*), *munja* (*Saccharum munja*), *S. arundinaceum*, *kans* (*S. spontaneum*), *Imperata cylindrica*, *ganeria* (*Narenga porphyrocoma*), *kus* (*Desmostachya bipinnata*), *khus* (*Vetiveria zizanioides*), *ulla* (*Themeda arundinacea*), *Chionachne koenigii*, *Alpudā varia*, etc.

There are a few patches of *sal* in the *chaur* and a few scattered trees such as *simul* (*Bombax ceiba*), *dhak* (*Butea monosperma*), *bauhinia* (*Bauhinia malabarica*), and *donla* (*Embllica officinalis*). *Ber* bushes (*Zizyphus jujuba*) are also commonly intermingled with the grass.

The *sal* forest extends from the southern edge of the *chaur* towards the north. It may be divided into three levels or stories : (1) canopy, (2) middle level or storey, and (3) ground level.

The canopy consists mainly of *sal* trees (*Shorea robusta*). However, other species of trees, such as *sains* (*Terminalia tomentosa*), *haldu* (*Adina cordifolia*), *bahera* (*Terminalia belerica*), *jhingan* (*Lannea woderi*), *jamun* (*Eugenia jambolana*), *kharpāt* (*Garuga pinnata*), and *tendu* (*Diospyros*

*tomentosa*), are also represented. In moist areas these trees replace *sal* as the dominant species.

The middle level or storey consists mainly of shorter trees, such as *rohini* (*Mallotus philippinensis*), *chilla* (*Casearia tomentosa*), *amaltas* (*Cassia fistula*), *lisora* (*Cordia dichotoma*), *gaya* (*Bridelia retusa*), etc.

The ground level is characterized by small trees, such as *gandhela* (*Murraya koenigii*), shrubs such as *Glycosmis pentaphylla*, *Clerodendron infortunatum*, *dhaia* (*Callicarpa macrophylla*), other shrubs, herbs, and patches of grass, as well as tree seedlings. The dominant grass species are *Imperata* sp. and *Chloris incompleta*.

The river-beds are characterized by trees, such as *shisham* or *sissu* (*Dalbergia sissoo*) and a few *khair* (*Acacia catechu*), in the canopy. Shrubs or vines are represented by *bhang* (*Cannabis sativa*) and *lantana* (*Lantana camara*).

The vegetation near Boxar is typical river bottom. However, in one patch of forest, trees like *shisham*, *bel* (*Aegle marmelos*), *khair*, and *ber* predominate. The Patairpani area is open forest, consisting of about 50% *sal* and 50% grass. The dominant grass in the stream beds here is *pater* (*Typha elephantina*). Besides the Ramganga River, another source of water in the main study area was about a one and one-half mile long *nullah* or water course in the center of the Dhikala *chaur*. Other nullahs present in the study area remain dry, except during the monsoon. The annual rainfall for this region is reported to be about 100 inches. Mean monthly maximum and minimum temperatures during the study period are given in Table 2.

TABLE 2

THE MEAN MONTHLY MAXIMUM AND MINIMUM TEMPERATURES RECORDED AT DHIKALA IN CORBETT NATIONAL PARK, U.P. (FEBRUARY 1-MAY 29, 1966)

Month	Means	
	Minimum	Maximum
February ..	41°F.	61°F.
March ..	56°F.	88°F.
April ..	64°F.	98°F.
May ..	75°F.	105°F.

TABLE 3

FOREST DEPARTMENT ESTIMATES OF RESERVOIR WATER LEVELS AFTER THE COMPLETION OF THE DAM ON THE RAMGANGA RIVER AT KALAGARH

Date	Water storage in M. ac. ft.	Approximate reservoir level (feet elevation)
October 8 ..	1,504	1188
November 1 ..	1,559	1191
December 1 ..	1,386	1181
January 1 ..	1,126	1164
February 1 ..	875	1147
March 1 ..	708	1133
April 1 ..	539	1116
May 1 ..	416	1102
June 1 ..	273	1084
June 16 ..	203	1075

### III. RESULTS

#### Population Density

The highest total count of chital in the study area was 1584. Chital in the *chaur* were generally quite easily tallied with the aid of a spotting scope from the watch towers. Those in the forest, however, were censused by the strip method, i.e. we walked in parallel lines and maintained sufficient distance between the lines to avoid duplication in the counts.

In addition to the study area, the highest count for areas to be submerged inside the park (parts of three compartments in the Dhikala Block, three compartments of the Gajpani Block, seven compartments of the Patairpani Block, and adjoining grasslands) was 922. Compartments I, II, IIIA, IIIB and IV of the study area (Map 3) will not be submerged. Almost 600 chital were counted in these compartments. Therefore my totals for the chital population in the park areas to be submerged was about 1900 ( $1584 + 922 - 600 = 1906$ ). Estimated water levels at different times of the year for this area are given in Table 3. It is almost certain that some animals were missed. Thus, it is estimated that as many as 2300 chital may have inhabited the area to be submerged during the course of the four-month study (February 1 through May 29). Total daily counts in the Dhikala *chaur* are given in Table 4.

TABLE 4

TOTAL DAILY COUNTS OF CHITAL ON THE DHIKALA *chaur*

Month	Date	Total chital
February 1966 ..	10	877
	11	920
	12	820
	14	898
	15	910
	16	940
	21	834
	24	924
	26	918
	27	975
March 1966 ..	28	963
	1	812
	3	954
April 1966 ..	6	976
	2	860
	5	703
	8	842
	12	694
	17	735
	21	922
	27	699
May 1966 ..	29	641
	30	767
	3	642
	5	631
	6	816
	7	669
	11	829
	12	685
13	811	
	14	892

About 1600 chital were primarily dependent upon the grass of the Dhikala *chaur* for forage. Although there was sufficient grass in the *chaur*, the areas along the forest edge were severely overgrazed. This overgrazing, coupled with the high frequency of dominance interactions and fighting, may indicate that the population density for the study area has passed the optimum level.

### Movements

The movement of chital is affected by numerous factors, such as temperature, weather, food, water, and disturbances. The role of temperature on their movements is evident from Table 5. During the four-month study period, the chital observed demonstrated a general pattern of movement. During February, most of the chital remained on the *chaur* throughout most of the day and night, taking rest in the



forest only a few hours at midday. But during March, April, and May, when the temperatures went up, they left the *chaur* earlier and then

TABLE 5

RELATIONSHIP BETWEEN TEMPERATURE AND TIME OF ENTRANCE AND EXIT FROM THE FOREST BY CHITAL

Date (1966)	Temperature		Hours of				
	Min.	Max.	going in forest	coming out of forest	Sunrise	Sunset	
March	2	55	89	11:30	14:30	06:30	18:12
	4	56	89	11:20	14:40	06:28	18:13
	6	50	78	10:50	14:30	06:26	18:14
	10	53	84	10:30	15:30	06:21	18:16
	31	57	91	10:00	15:40	06:03	18:23
April	2	61	96	09:40	16:10	06:01	18:24
	4	60	98	09:30	16:20	05:59	18:25
	8	59	92	09:00	16:00	05:55	18:26
	11	62	97	08:10	16:30	05:53	18:27
	14	63	98	08:00	16:40	05:50	18:28
	17	64	98	07:40	16:50	05:47	18:29
	21	63	100	07:20	17:10	05:44	18:31
	25	65	104	07:00	17:40	05:41	18:33
	28	71	103	07:00	17:40	05:39	18:34
30	69	102	07:10	17:10	05:37	18:35	
May	3	63	105	06:20	18:10	05:35	18:36
	4	69	108	06:10	18:25	05:35	18:36
	5	68	109	06:00	18:10	05:34	18:37
	6	71	108	06:10	18:10	05:33	18:37
	8	71	106	06:20	18:00	05:32	18:38
	10	68	97	07:30	16:30	05:31	18:39
	12	70	90	07:45	15:45	05:30	18:40

returned to graze between 14:30 to 18:25 hours until 06:10 or 11:30 hours the following morning. During periods of rainfall or during cloudy or foggy weather the chital remained on the *chaur* for longer periods of time. This can probably be correlated with lower temperatures on these days.

Chital are primarily grazers and prefer the shorter green grasses or the more palatable green shoots. Since there were very few patches of grass inside the forests, they regularly came out on to the grassy *chaur* to graze. It was reported by members of the Forest Department staff that during November and December chital were found in the riverbeds. But, as the new grass shoots began to appear in January after the grasslands had been burned by the Forest Department, they began to congregate on the *chaur*. Besides grass, chital were observed to eat the leaves of trees, such as *maljhan* (*Bauhinia vahli*), *kachnar* (*B. mala-*

*barica*), *lisora*, *gandhela*, and *gaya* (*Bridelia retusa*); shrubs such as *Glycosmis pentaphylla* and the fruits of *bahera* (*Terminalia belerica*) and *aonla* were also eaten.

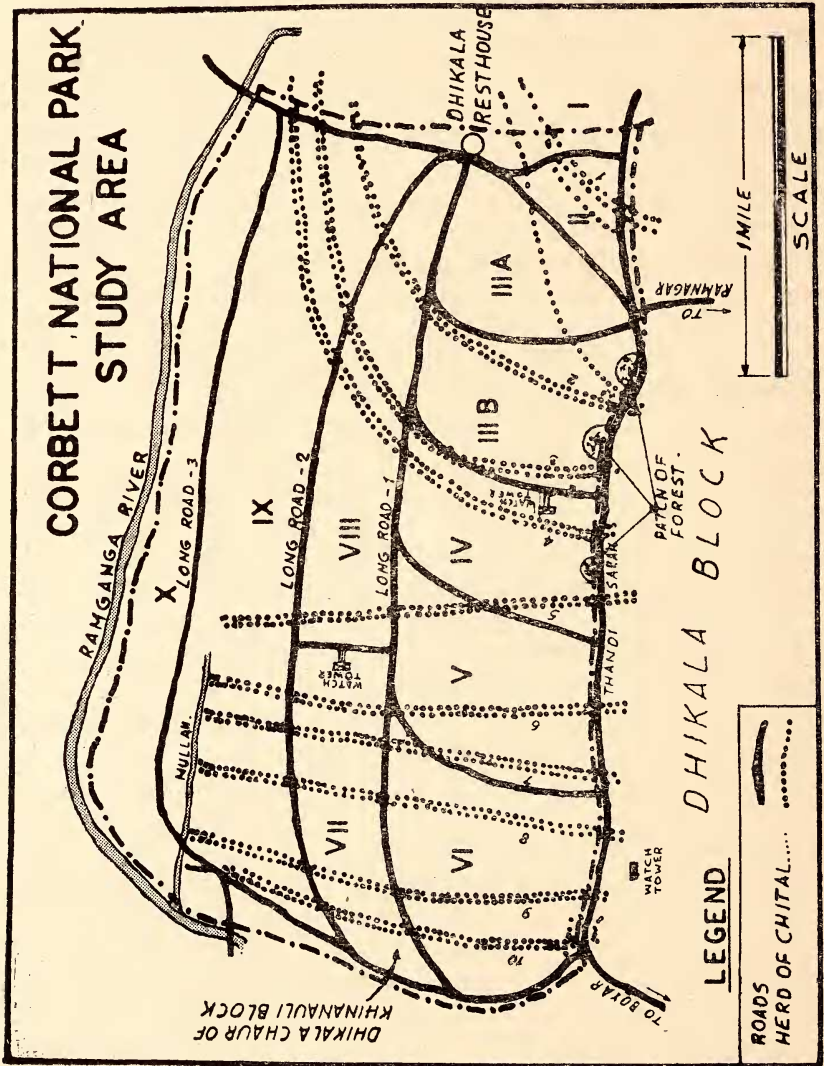
Water plays a major role in the movement of chital. Herds in different compartments of the study area moved across the *chaur* to reach either the nullah in compartment IX or the Ramganga River (Map 3). Most of the animals went to water in the late evening, but a few were also occasionally observed to drink in the early morning.

Due to the movements of visitors and crews working to clear-fell the areas to be submerged by the backwaters of the dam, disturbances in the Dhikala *chaur* were often excessive. However, moving vehicles or bicycles did not normally disturb the chital to any appreciable extent. Stopped vehicles, domestic elephants, and people on foot generally caused the chital to seek refuge in the near-by forests. The number of roads in this area are excessive and many disturbances could probably be minimized if only a few of the roads were maintained and the others were closed. Predators, such as tiger or leopard, also disturbed chital grazing on the *chaur*. The animals also appeared to be more easily frightened by our presence after having previously been frightened by a predator.

Daily observations enabled the senior author to distinguish the territories of ten more or less stable herds of chital (Map 3). Some of these were readily distinguished by 'marker' individuals or those which had readily observed abnormalities, i.e. antler development. For example, herd 1 of compartment II occupied a territory covering compartments I and II. Herd 2 of compartment IIIB occupied a territory covering parts of compartments IIIB, IV, VIII, IX, X, IIIA, II, and I, and so forth. All ten herds also occupied areas from one-half to two miles inside the forests adjoining the *chaur*. Frequent mixing of herds was also observed, particularly when the chital were disturbed, i.e. by men or predators.

### Sex Ratios and Age Composition

Age composition and sex ratio data were most commonly recorded when the chital made either their exit from or their entry into the forests. At this time they would normally move slowly in single file, enabling one to sex and age entire groups accurately. Watch towers were also used for this purpose. A more or less 1 : 1 sex ratio may usually be expected in an area which is free from selective shooting or predation. The percentages of adult females observed as compared to adult males for February, March, April, and May were 52, 58, 60 and 53% respectively. The variations are not significant and the observed sex ratio always approximated 1 : 1. The adult female-young ratios for February, March, April, and May were 33, 37, 37 and 31%. This indicates that the main fawning season was probably over by mid-March. Further



Map 3. Study area in the Dikhala *chaur* of Corbett National Park, U.P., with the daily movements of different herds of chital

information concerning sex ratios, age composition, and antler development on a monthly basis is given in Table 6.

### Reproduction

Seasonal sexuality in chital males is manifested by the growth of antlers and mating behaviour. During February, March, April, and May the percentages of males observed with hard antlers were 2, 9, 12, and 51% respectively. The onset of the main rut in May was characterized by an increased frequency of fighting. Males appeared to eat less and frequently moved in search of females. The necks of some stags began to swell and their colouration became darker. The infra-orbital glands began to secrete a musky amber-coloured wax-like fluid, which trickled down the face.

The frequency of mating calls also notably increased from February through May. As presented in Table 7, the mean number of calls recorded per hour on a monthly basis increased from three during the later part of February to 11 during May. It appeared that the rutting season was just attaining its peak when the study was terminated the last of May. It is also evident that mating calls or bellows were more often given in the evening than in the morning. Mating calls also were frequently heard at night, although their frequency was not recorded. Calls were rarely heard between the late morning and late afternoon hours.

The frequency of mounting and copulation, as would be expected, also increased between February and the end of May. As recorded in ten observations, these typically involved the male chasing the female, frequent eversion of the penis, repeated licking of the muzzle, retraction of the lips from the upper gum while holding the muzzle up, sniffing of the vulva, mounting, insertion of the penis into the vagina, licking of the penis, and retraction of the penis into the sheath. Insertion of the penis into the vagina was sometimes accomplished only after numerous attempts. Mating males also occasionally had to challenge or threaten other approaching males and on a few occasions severe fighting was observed.

Generally speaking, chital are not aggressive animals. Sometimes, however, severe fights among them are witnessed. Observed fighting was either between males or between females, it was never between animals of opposite sexes. Fights among young males with spike antlers in velvet on three occasions involved dominance interaction, slapping at each other with the forefeet and pushing each other with the neck, while standing on their hind legs for as long as three or four minutes. Similar fighting between females was observed on four occasions near salt licks. Besides fighting, aggression was represented by chasing, butting, and the turning of the head or body towards another animal. Mild forms of

TABLE 6  
CHITAL AGE COMPOSITION AND SEX RATIOS AS OBSERVED ON A MONTHLY BASIS

Month	Spike velvet	Spike hard	recently lost antlers	Knob	4"-8" velvet	9"-15" velvet	9"-15" hard	16"-22" velvet	16"-22" hard	23"-29" velvet	23"-29" hard	30"-36" velvet	30"-36" hard	37"-43" velvet	37"-43" hard	Total no. of ♂♂	Total no. of ♀♀	Total no. of young	Grand total	% of ♂♂	% of ♀♀	% of young	% of hard antlered	% of velvet antlered	Sex ratio
February 1966	40	35	120	0	87	39	0	27	7	32	0	11	0	0	0	398	434	215	1047	38	41	21	10	90	♂:♀ 1:1
March 1966	6	3	45	0	22	16	2	16	1	13	1	15	8	0	0	148	200	116	464	31	43	26	10	90	3:4
April 1966	19	9	10	10	16	45	1	48	5	23	5	61	16	17	4	289	421	255	965	30	43	27	14	86	2:3
May 1966	26	6	0	13	0	10	0	25	23	14	12	21	27	7	20	204	229	103	535	38	42	20	43	57	1:1

fighting between males involved the simple interlocking of antlers and slight pushing. More severe fighting involved antler interlocking and severe 'jousting'. This form was most obvious among combating males during May.

The female gives birth after completing a gestation period of about seven and one-half months. Many newborn young were seen in February. Fawning also continued up until the first of May and then decreased considerably. Young from the previous year were also attaining adult size at this time.

Dominance interactions were particularly evident between males with hard antlers or antlers in the later stages of development. Such interactions generally involved two to seven animals walking in parallel lines or in circles with a stiff, slow gait—heads slightly bent to the side, ears laid back on the neck, and with the tail sometimes raised. Larger males usually dominated younger or smaller males, which moved away from them. Although numerous dominance interactions were observed in February, March, and April, these usually did not lead to fighting. When many males had hard antlers in May, however, dominance interactions often led to severe fighting.

Females were observed to hide their newborn young in the grass. On three occasions females were seen to leave a grazing herd to caress and suckle their young, which were lying elsewhere. Caress was represented by licking of the fawn's body, particularly the rump region. Suckling time varied from 45 seconds to five minutes. In 9 out of 13 suckling observations the mother again left the young.

### Miscellaneous Observations

It was noted that when chital came out of or entered into the forest areas they almost invariably used narrow paths or game tracks. These were most numerous near salt licks and approaching the Thandi Sarak road, but diminished inside the forest or towards the center of the *chaur* where the chital were generally scattered. Chital appear to regularly use the artificial salt licks, which were provided by the Forest Department. The chital made shallow pits with the help of the forefeet and teeth and then ate the salty soil. The length of time that individuals licked salt varied from 2 to 37 minutes.

Chital are very social animals and are rarely encountered apart from a group or herd. The number of individuals counted in groups varied from 2 to 315. Herds generally consist of males, females, and young of all ages. Very few solitary males or females were seen. In a few cases all male groups were seen. However, most of the time males were seen with females, although during February and March they had a tendency to remain to one side of the herd when it was grazing more or less in a line on the *chaur*,

A matriarchal social system was indicated by the fact that females were generally more alert than males. Also, females led the way 110 times out of 136 occasions when chital were observed entering or coming out of the forest.

## VI. OTHER ANIMALS

Tiger and leopard probably play the major role in controlling the chital population in Corbett. The carcasses of four male chital, three adults and one yearling, killed by tiger or leopard were found in the forest areas adjoining the *chaur*. Three of these had large antlers in velvet. This may indicate that heavy or large antlers, as well as age, may be a factor in predation. A jackal on one occasion broke the lower jaw of a young chital, which was captured later by one of the forest guards. On four occasions chital were observed to run when approached by jackal. An eagle was observed to swoop down upon a very small chital and carry it away. Several adult female chital followed after the flying bird.

The actions of other animals also affect the behaviour of chital. For example, on two occasions chital were observed to follow mixed groups of common langurs and rhesus monkeys. They were feeding upon the leaves and fruits dropped from the tops of the trees. The alarm calls of both langur and rhesus also warn chital, particularly when in the forests, of the presence of predators such as leopard.

Although chital were observed to graze within a few hundred feet of wild elephants, they did not mix or intermingle with them. On nine occasions chital were observed to enter areas occupied by elephants much later than was their normal pattern. However, chital appeared to freely mingle with wild pig, hog deer, and sambar. No aggressive interactions were observed between these species. Birds, such as mynas and tree pies, would frequently light on the backs of chital and appeared to feed upon external parasites. This would probably be advantageous to the chital.

A recently born chital young examined on May 19 had an infection of maggots in the vicinity of the umbilical cord. Amphistome flukes (*Calicophon cauliorchis*), identified by the Zoological Survey of India, were collected from the rumens of two dead chital. This parasite may cause amphistomiasis.

### Hog Deer

In addition to chital, hog deer will also suffer when grassland areas in Corbett are submerged by the backwaters of the Ramganga River dam. Greater concentration on chital observations, the relatively small size of hog deer, the dense grass which they generally inhabit, and their somewhat secretive habits prevented us from obtaining a total count of

the hog deer in the study area. However, we guess there were at least 100 hog deer present on the *chaur* of the study area.

Hog deer were observed to remain in the *chaur* throughout the day and night. In comparison to chital, they grazed in smaller or more restricted areas. It was difficult to note the time of grazing, but they generally grazed intermittently from late afternoon until late the following morning. In midday they would seek refuge in the tall grasses of the

TABLE 7  
FREQUENCY OF MATING CALLS BY MALE CHITAL ON AN HOURLY BASIS

Month	Date	Hour when mating calls were counted	Number of mating calls per hour	Mean number of calls per hour	Maximum no. of bellows in one call
February	14	07:00-08:00	3	3	8
	16	16:50-17:50	4		8
	18	06:50-07:50	3		7
	21	07:10-07:40	2		7
	22	06:30-07:00	3		8
	26	06:00-07:00	3		7
	27	06:20-07:20	2		5
March	3	06:15-07:15	3	3.5	
	28	05:45-06:45	4		7
April	5	05:45-06:45	5	6	7
	6	05:45-06:45	4		8
	8	05:45-06:45	5		6
	11	18:45-19:45	5		6
	12	05:45-06:45	6		6
	13	05:45-06:45	7		6
	13	17:40-18:40	4		6
	15	05:45-06:45	5		5
	17	05:45-06:30	5		6
	17	18:00-19:00	6		6
	21	05:45-06:20	5		7
	21	18:45-19:45	7		6
	23	17:45-18:45	8		6
	24	17:45-18:45	7		6
	25	04:50-05:50	6		7
	25	17:45-18:45	7		6
	27	04:45-05:45	5		7
29	05:00-05:45	7	7		
29	18:10-19:00	8	7		
May	4	04:45-05:45	8	11	7
	4	18:20-19:20	9		7
	5	04:95-05:45	8		7
	5	18:00-19:00	9		7
	8	04:45-05:45	9		7
	11	04:45-05:45	9		7
	13	04:45-05:45	10		7
	14	04:45-05:45	11		7
	14	18:20-19:20	13		7
	16	04:45-05:45	12		7
	19	04:45-05:45	11		6
	19	18:20-19:20	13		7
	20	04:45-05:45	13		6
20	19:00-20:00	16	7		



*chaur*. Four groups of hog deer were repeatedly seen lying in the open in compartments IIIB, IV, and VI. But, as the temperature went up in April and May and as the tall grasses were flattened, these groups then sought out tall grassy areas or the shade of scattered trees to take rest. Two groups of hog deer in compartment X were seen lying in the tall grass repeatedly, even in summer during the heat of midday.

Hog deer are social animals and in Corbett they usually remained in groups of from three to seven of both sexes and all ages. The males, however, had a tendency to graze somewhat apart from the groups of females and young. When disturbed they would usually take cover in the tall grass, rather than in the near-by forests as did the chital. No fighting, dominance interactions, or play among hog deer was observed.

Hog deer fawns were first observed during the last week of March. Recently born fawns then continued to be seen up until May. The reported gestation period is about eight months (Asdell 1964). The rut, therefore, was probably between August and October. Information concerning the sex ratio, age composition, and antler development for hog deer observed is given on a monthly basis in Table 8.

### Sambar

Sambar are usually somewhat solitary forest dwellers and it was difficult to collect much information concerning them. However, seven sambar were repeatedly observed in the study area. It was noted that a group consisting of an adult male, three adult females, and two young usually occupied parts of compartments II, III, IV, VIII, IX, and X. A solitary adult male was seen frequently in compartments V, VI, and IX. This suggests that sambar may be territorial. Groups numbering up to six were seen and they generally contained one or two adult males.

Sambar were seen only occasionally in the *chaur* during February and March. Although they are considered to be primarily browsers, during April and May, they were observed quite regularly to enter the *chaur* in the evening and remain until 05·10 to 07·30 hours the following morning. They were also seen eating short grasses in the forest and hilly areas. The colour of their coat changed from dark grey in February and March to a whitish grey in April and May. During the first part of May, 33 out of 55 sambar seen had a whitish grey coat.

Small young sambar were rarely seen. A lactating female was killed by a tiger on February 23 and two young which were about three months old were seen in the second week of March. This suggests that the fawning period may be during December or January. Asdell (1964) reported that the gestation period for the sambar is eight months. Information on sex ratios, age composition, and antler development for sambar observed is given on a monthly basis in Table 9.

TABLE 8

HOG DEER AGE COMPOSITION, SEX RATIOS, AND ANTLER DEVELOPMENT AS OBSERVED ON A MONTHLY BASIS

Month	Males with recently shed antlers	Antlers from 4"-6" velvet	Antlers from 7"-12" velvet	Hard antlers	Total males	Total females	Total young	Total deer	Sex ratio male: female	% of males	% of females	% of young	% males with velvet antlers	% males with hard antlers
Feb. 1966	2	0	0	4	6	11	6	23	1:2	26	48	26	33	67
March 1966	5	0	2	4	11	15	7	33	4:5	34	45	21	63	37
April 1966	1	2	3	0	6	14	8	28	1:2	21	50	29	100	0
May 1966	1	0	3	0	4	5	3	12	1:1	33	25	33	100	0
Total	9	2	8	8	27	45	24	96	3:5	28	47	25		

TABLE 9  
SAMBAR AGE COMPOSITION, SEX RATIOS, AND ANTLER DEVELOPMENT ON A MONTHLY BASIS

Month	Males with spike hard antler	Males with shed antlers	Antler over 4' velvet	Hard antlers	Total males	Total females	Total young	Grand total	Sex ratio males females	% of males young	% of females young	% of males with velvet antler	% of males with hard antler
Feb. 1966	0	0	0	1	1	2	1	4	1:2	25	50	0	100
March 1966	0	0	0	3	3	11	8	22	1:3	14	50	0	100
April 1966	0	1	1	1	3	23	8	34	1:7	9	67	67	33
May 1966	1	2	4	2	9	36	10	55	1:4	16	66	67	33
Total	1	3	5	7	16	72	27	115	1:4	14	63	23	

TABLE 10  
BARKING DEER SEX RATIOS AND ANTLER DEVELOPMENT ON A MONTHLY BASIS

Month	Males in velvet antler	Males in hard antler	Total males	Total females	Grand Total	Sex ratio	% of males in hard antler	% of males in velvet antler
March 1966		4	4	5	9	1 : 1	100	0
April 1966	2	5	7	5	12	1 : 1	71	29
May 1966	6		6	3	9	2 : 1	0	100
Total	8	9	17	13	30	4 : 3		

### Barking Deer

Barking deer were never seen on the *chaur*, but were frequently observed along the roads and in the adjoining forests. Generally they were solitary, but were occasionally observed in pairs or groups of two. One pair near compartment IIIB and two males near compartment VI were repeatedly seen together. There was an indication that they may also be territorial. Asdell (1964) claims that the young are born in July and August. No small young were observed. Therefore no definite information can be given about the reproduction of this species in Corbett. Information concerning sex ratios and antler development is given in Table 10.

### V. RECOMMENDATIONS

The following recommendations are made :

1. That forest areas adjoining the *chaur* areas to be submerged be clear-felled to create grasslands to compensate for the grazing habitat that will be lost. Artificial salt licks should also be provided in these areas to help attract animals, such as chital and hog deer, into them.

2. That controlled burning by the sanctuary staff be practised on the grassland areas of the park. Whenever possible burning should be done as early as possible in the season and at a time when it is not detrimental to ground-nesting birds or other animals.

3. That all domestic livestock grazing inside Corbett be prohibited. The Forest Department has already made very good progress towards this end.

4. That, in so far as is possible, the exploitation of forest produce inside Corbett be stopped. Exploitation should be completely prohibited in at least a few key wild life areas.

5. That the main roads inside the park be improved. If possible, they should be metalled. However, in some areas, particularly the Dhikala *chaur*, the number of roads should be greatly reduced.

6. That night driving inside the park be prohibited.

7. That transportation for visitors be provided at reasonable rates from Ramnagar to Dhikala.

8. That information concerning the park (i.e. pamphlets, folders, post cards, etc.) be made available through the Department of Tourism. Although a folder concerning the park is available at the office in Ramnagar and in Corbett, it should also be made available in the Tourist Bureaus.

9. That Forest Department personnel who show a genuine interest in wild life be employed in the park and that they be trained in the basic concepts of wild life management. Salaries in keeping with the specialized work of wild life management should also be provided.

10. That members of the Forest Department staff be enabled to visit other parks and sanctuaries in India to help them to better understand how they can improve and develop Corbett as a major tourist attraction.

11. That visitors visit the Dhikala *chaur* as a group to observe wild life and that they be accompanied and supervised by a member of the Forest Department staff.

12. That evening programmes (i.e. slide lectures) by the Forest Department staff concerning the park's wild life be scheduled regularly for visitors. Also that wild life films, specifically about Indian wild life, be solicited for use in the evening cinema being presented for visitors at Dhikala.

13. That attempts be made to show tiger regularly to visitors from well constructed machans. The provision of baits at regular intervals and the construction of artificial water-holes at these locations would probably help increase the possibilities of visitors regularly seeing tiger. There is also the possibility that the same could be done with leopard.

14. That reservations for visitors to Corbett be handled at Ramnagar, rather than in Lucknow.

15. That the possibility of regularly scheduled Department of Tourism bus tours from Delhi to Corbett be thoroughly investigated.

16. That a gift shop, operated by private enterprise but supervised by the Forest Department, be opened at Dhikala. Besides souvenirs, foodstuffs, drinks, postcards, etc., books (i.e. on the birds and mammals of India), should also be on sale.

17. That, although private enterprise should be encouraged, the Forest Department should strictly supervise the operation of tourist facilities within the park. Adequate staff (cooks, bearers, etc.) should also be provided at Forest Rest Houses other than at Dhikala.

18. That scientific studies of the park's wild life by qualified personnel be encouraged and that facilities, such as housing, be provided whenever possible, as was done during this study.

19. That wild life observations both by the staff and by visitors be kept in a permanent record at Dhikala.

## VI. ACKNOWLEDGEMENTS

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N. S. Negi (Assistant Wild Life Warden of Corbett), and Sohan Singh (Wild Life Guard).

The Forest Department is to be commended for their management of Corbett and it is our sincere desire that this study will be of value to them in the future management of this outstanding wild life area.

VII. LITERATURE CONSULTED

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